Discussion Questions for Cold Water Refugia Workshop

Steelhead

Summary – Summer steelhead use CWR extensively between Bonneville Dam and John Day Dam when temperatures exceed 19ºC, which is typically from early July through early September during the peak of the run. Steelhead will use CWR for extended periods (2-4 weeks) in this reach prior migrating to upstream natal tributaries. Recent adjusted[1] adult survival from Bonneville Dam to McNary Dam for Snake River Steelhead is 90% (below FCRPS BiOp 95% target) and for Upper Columbia Steelhead is 93% (above BiOp 85% target). Generally, Snake River Steelhead migrate in warmer conditions and use CWR more than Upper Columbia Steelhead. Steelhead harvest is higher in CWR areas relative to the main channel resulting in less survival for Steelhead that use CWR versus those that don't.

Discussion Questions:

- Initial Feedback
  - Did EPA accurately characterize the scientific studies?
  - What additional scientific studies or information did EPA miss?
- Steelhead Migration Patterns
  - What part of the Columbia River mainstem (i.e., depth, part of channel, etc.) do Steelhead use during their upstream migration when the River exceeds 19-20ºC?
  - What is the spatial extent of use of each known CWR area? (i.e., plume area, lower portion of tributary, how far upstream)
    - Eagle Creek, Herman Creek, Wind River, Little White Salmon, White Salmon, Klickitat, Hood River, Deschutes River, others?
  - What tributaries do Steelhead overshoot and seek CWR upstream then return later to move upstream and spawn?
  - To what extent do Steelhead use CWR below Bonneville Dam?
    - Cowlitz, Kalama, Lewis, others?
    - Do Steelhead use these for the same duration as above Bonneville?
- Importance of CWR Use
  - How important is CWR use between Bonneville Dam and John Day Dam to Steelhead survival and egg viability?
  - What are the trade-off of CWR use (e.g., disease, harvest, etc.,)
  - Is data available to subtract harvest related mortality in CWR areas and quantify the benefits of CWR use vs non-use?
  - To what extent are elevated river temperatures contributing to the 10% unaccounted loss of SR Steelhead between Bonneville and McNary Dams
  - If the CWR areas did not exist in this reach, how would that effect survival rates?

[1] Adjusted refers to the FCRPS BiOp methodology of calculating survival after accounting for harvest and straying loss.

- Sufficiency of CWR
    - Is the available CWR in the Columbia River (mouth to Snake River) sufficient to support *current* and *recovered* Steelhead populations?
    - Is EPA's rough estimate of 80,000 Steelhead using CWR between Bonneville and John Day Dam about right?
    - What is the maximum density of adult fish each CWR area can support at one time?
    - What metric can be used to define "sufficiency"
    - How much CWR existed in the Columbia River historically, how did Steelhead use it, and is this an indicator of sufficiency today?
- Additional Analysis and Studies
    - How can pit tag and other existing information be analyzed to address some of the above questions?
    - Would additional pit tag antennae arrays in CWR tributaries be helpful? If so, which tributaries?
    - What future field study designs would be helpful to address some of the above questions?

Chinook

Summary – Chinook use CWR when temperatures exceed 21ºC. Chinook have a higher threshold for CWR use and use CWR for less duration that Steelhead, typically for hours and days versus weeks. The latter part of the Summer Chinook run and the early part of the Fall Chinook run are exposed to 21ºC temperatures in late July and August. Recent Snake River Fall Chinook adjusted survival from Bonneville Dam to the McNary Dam is 92% (above FCRPS BiOp 88% target). Summer Chinook survival is a concern in this reach, with decreased survival associated with elevated temperatures. Snake River Spring-Summer Chinook adjusted survival is 88% (below FCRPS 95% target).

Discussion Questions:

- Initial Feedback
    - Did EPA accurately characterize the scientific studies?
    - What additional scientific studies or information did EPA miss?
- Chinook Migration Patterns
    - What part of the Columbia River mainstem do Chinook use during their upstream migration when the River exceeds 20-21ºC?
    - What is the spatial extent of use of each CWR area (i.e., plume vs tributary, how far upstream)?
        - Eagle Creek, Herman Creek, Wind River, Little White Salmon, White Salmon, Klickitat, Hood River, Deschutes River, others?

    - Could the percentage of Chinook use of CWR be higher than reported if use in the tributary plumes are better documented?
    - Do Chinook use multiple CWR areas like “stepping stones” during their migration?
- Importance of CWR Use
    - Do the data exist to compare the survival of Chinook that use verses don’t use CWR when temperatures exceed 20-21ºC?
    - How important is use of CWR to Chinook survival and egg viability?
        - How can we relate thermal exposure (observed or modeled) to survival probability and egg viability?
    - What are the trade-offs for CWR use?
        - Do Summer Chinook “pay a price” for extended CWR use due to delayed migration timing and likely exposure to higher mainstem temperatures than if they did not use CWR
    - To what extent are elevated river temperatures contributing to the 12% unaccounted loss of SR Spring-Summer Chinook between Bonneville and McNary Dams
- Sufficiency of CWR
    - Is the amount of CWR in the Columbia River (mouth to Snake River) sufficient to support current and recovered Chinook populations?
    - What is the maximum density of adult fish each CWR area can support at one time?
    - What metric can be used to define “sufficiency”
- Additional Analysis and Studies
    - How can pit tag and other existing information be analyzed to address some of the above questions?
    - Would additional pit tag antennae arrays in CWR tributaries be helpful? If so, which tributaries?
    - What future field study designs would be helpful to address some of the above questions?

Sockeye

Summary – There are limited studies documenting Sockeye use of CWR in the Columbia River. Columbia River temperatures of 20-21ºC result in high levels of sockeye mortality. Sockeye survival is correlated with temperatures when they pass Bonneville Dam with decreased survival when temperatures are 18ºC and higher. Snake River Sockeye survival from Bonneville Dam to McNary Dam is around 60% from 2010-2014, with only 15% survival in 2015. Snake River sockeye survival from Bonneville to McNary is: less than McNary to Lower Granite Dam; less than upper Columbia Sockeye due to later migration timing; and less for transported juveniles compared to in-river juvenile migrants.

Discussion Questions:

- Initial Feedback
  - Did EPA accurately characterize the scientific studies?
  - What additional scientific studies or information did EPA miss?
- Sockeye Migration Patterns
  - What part of the Columbia River do Sockeye use during their upstream migration when the River exceeds 18C?
  - To what extent do Sockeye use CWR as "stepping stones" to mitigate the effects of elevated temperatures?
- Importance of CWR Use
  - Do data exist to compare the survival of Sockeye that use verses don't use CWR when temperatures exceed 18C?
  - How important is use of CWR to Sockeye survival and egg viability?
    - How can we relate thermal exposure (observed or modeled) to survival probability and egg viability?
  - What are the trade-offs for CWR use?
    - Do Sockeye "pay a price" for extended CWR use due to delayed migration timing and likely exposure to higher mainstem temperatures than if they did not use CWR
- Sufficiency of CWR
  - Is the amount of CWR in the Columbia River (mouth to Snake River) sufficient to support current and recovered Sockeye populations?
  - What is the maximum density of adult fish each CWR area can support at one time?
  - What metric can be used to define "sufficiency"
- Additional Analysis and Studies
  - How can pit tag and other existing information be analyzed to address some of the above questions?
  - Would additional pit tag antennae arrays in CWR tributaries be helpful? If so, which tributaries?
  - What future field study designs would be helpful to address some of the above questions?